their appearance. These may have been nuclei of the white corpuscles. In several places in the field under the microscope, granular nucleated cells, larger than white corpuscles, were observed.

The blood in a case of pseudo-leucocythæmia was affected by the drug in the same manner as normal blood.

[Saponin immediately arrests the movements of spermatozoa and other ciliated cells. It destroys at once all infusorial life with which it comes in contact, but fails to influence in the least degree the movements of vibrios and bacteria.]

[*To be Continued.*]

ART. IV.—RETROGRADE AND LATERAL MOVEMENTS WITH HYPNOTISM.

BY ISAAC OTT, M. D.

WHEN cold is applied to certain definite regions of the skin in pigeons, they exhibit retrograde movements alternating with fits of stupor. The agent, so far, has been rhigolene, to produce the necessary cold. Ether, when vaporized, was totally unable to produce any effect. The region to which the cold must be applied is the skin of the back of the neck. These phenomena were first observed by Dr. S. Weir Mitchell. I have lately been studying the effect of irritants on the skin of pigeons, and the seat of the phenomena produced. I found that ether, alcohol, chloroform and nitrite of amyl were powerless to produce the effects seen after the application of rhigolene. If, however, bisulphide of carbon was dropped on the skin of the back of the neck, then all the phenomena produced by rhigolene ensued in a marked manner. Thus a single drop of the bisulphide of carbon applied to the back of the neck of the pigeon caused him to retrograde and to pass into states of quietude. When bisulphide of carbon is applied to the skin of the neck in pigeons, the birds run forward as if no agent was acting on them, but suddenly they commence to run backwards, it being quite evidently against their will, as they

seek to overcome the tendency. During the period of quietude, the body sinks down somewhat, the head being drawn in close to the body and bent towards the ground to a considerable extent. That these phenomena are due to a simple irritation of the nerves, is proved by an experiment where I attached a small bull-dog forceps to the skin on the back of the neck, when similar retrograde movements ensued, followed by a period of quietude. As remarked by Dr. Mitchell, these phenomena are reflex in their nature. Here the mechanical irritation of the sensory nerves is reflected on the central nervous system, causing it to evolve the phenomena under consideration. To more accurately determine the seat of these phenomena, I have made some experiments: In a pigeon under ether, the skull was trephined and the cerebellum broken up. When the bird recovered from the operation, that is several hours afterwards, rhigolene was applied and the bird exhibited the same phenomena as an uninjured one. In another pigeon the skull was trephined and the cerebrum broken up; then, after a period of several hours, the bisulphide of carbon was dropped on the skin of the neck, when the pigeon began to make retrograde movements and to have periods of quietude. The bird did not run forward, which was due normally to cerebral action when the bisulphide was applied. Hence, the forward movement after the application of either rhigolene or bisulphide of carbon, was due to cerebral activity. These series of experiments seemed to demonstrate that the cervical reflex had its central origin at the base of the encephalon, for the cerebrum and cerebellum did not seem necessary for the production of the phenomena in question. Section of the semicircular canals had no effect on these phenomena, except to make them more complicated.

Now, when the cerebrum is destroyed, the nervous system of the bird is a mere automaton, played upon by appropriate external agents. These agents, in the phenomena under consideration, are rhigolene, bisulphide of carbon and mechanical irritation. The inquiry now arises: how do you explain the phenomena in question? It is well known, since the time of Magendie, that in the corpora striata are seated ganglia, causing the animal to run backward Not only does the bisulphide,

when placed on both sides of the median line of the back part of the neck, cause the bird to run backward, but when it is placed to the right of the median line, the bird runs in a circle towards the left. A drop on the left of the median line causes the bird to run to the right. The rule here is, that the bird makes a circular movement opposite the irritated side. It has seemed to me that these phenomena of lateral movements in pigeons can be explained as follows: According to Chauvean, the sensory fibres do not decussate in pigeons, and if an irritation is made on one side of the median line the impression ascends on the same side, and calls the retrogressive ganglia of that side only into activity, which activity is expressed on the opposite side of the body, due to the motor decussation. Now the retrogressive ganglia are in power over one side of the brain, whilst the other side of the brain, under the influence of the cerebrum, is disposed to move the opposite side of the body forward; hence the bird cannot go directly forward, but deviates to the side where the retrogressive ganglia have shown their activity—the bird moves in a circle. The action might be compared to that of driving a horse forward, and at the same time strongly pulling one of the reins, the checking rein corresponding to the side of the brain under the influence of the retrogressive ganglia. If now the skin on both sides of the median line is irritated, then the retrogressive ganglia on both sides of the brain are dominant, and the bird moves backward, notwithstanding all efforts to prevent it. It might be compared to a horse pulled on his haunches by two strong check-reins. The periods of quietude, either preceding or following the external application of bisulphide of carbon, are to be explained. It is well known by Kircher's "experimentum mirabile," that chickens, when held down, pass into a state, called by Czermak, hypnotic. In fact, Czermak has been able to produce a hypnotic state in pigeons and other birds. He found if he held the pigeon on his back and rubbed him softly in the parotid region, that the pigeon closed and opened his eyes, made strong respiratory movements and passed into a state of perfect quietude, called by him hypnotic. In my experiments on pigeons, the state of quietude is actually hypnotic, as the bird exhibits similar phenomena, opens and closes his eyes, breathes heav-

ily, and remains perfectly quiet. It strikes me that this hypnotic state can be explained by sensory irritation, produced by the bisulphide of carbon calling ganglia at the base of the brain into activity, which ganglia have an inhibitory power. That sensory irritation may come into play is shown by Levissons' experiment with the frog, where simply tying his anterior extremities and placing him on his back keeps him in a state of quietude. The rapid breathing also indicates a strong sensory irritation. In my experiments, the temporary irritation explains the temporary hypnotism. With this method of viewing matters, the phenomena of hypnotism have nothing to do with the cerebrum, but are caused by ganglia at the base of the brain inhibiting the will.

In cats and rabbits the application of bisulphide of carbon to the skin on the back of the neck, causes them to run forward and to leap up in the air. I have not been able in animals, so far, to produce movements similar to those seen in pigeons, but hope shortly to find some animal in which they can be produced. This whole subject is important, not only to the physiologist, but also to the pathologist.